Public Health Assessment

DELTA SHIPYARD

HOUMA
TERREBONNE PARISH
LOUISIANNA

EPA Site No: LAD058475419

Prepared by:

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Foreword

Congress established the Agency for Toxic Substances and Disease Registry (ATSDR) in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law. This law sets aside money to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency (EPA) and individual states regulate investigating and cleaning up of the sites.

After 1986, the law required ATSDR to conduct a public health assessment at each of the EPA National Priorities List (NPL) sites. The NPL contains the most serious uncontrolled or abandoned hazardous waste sites throughout the United States and its territories. The aim of ATSDR's assessments is to find out if people are being exposed to hazardous substances and, if so, whether those exposures are harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments and focused health consultations when petitioned by concerned people. Environmental and health scientists from ATSDR and from the states ATSDR has cooperative agreements with conduct public health assessments. The public health assessment process allows the scientists and public health assessment partners to be flexible in how they present findings about the public health effects of hazardous waste sites. The flexible format allows health assessors to provide important public health messages to affected populations in a clear and expeditious way.

Exposure: As the first step in the assessment, ATSDR scientists review environmental information (data) to decide how much contamination is at a site, where it is, and how it could affect the health of people exposed to it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When available information is not enough to determine whether exposures could affect the health of people, the report will indicate what additional data the scientists need.

Health Effects: If the review of the environmental data shows that people have been, or may be, exposed to hazardous substances, ATSDR scientists evaluate whether these exposures may be harmful. ATSDR recognizes that children may be more vulnerable to these harmful effects because of their play activities and their growing bodies. ATSDR considers children and developing fetuses to be more sensitive and vulnerable to hazardous substances unless data are available to suggest otherwise. Thus, ATSDR considers the health of the children first when evaluating the health threat to a community. The potential health effects to other high-risk groups within the community (such as the elderly, chronically ill, and people who engage in high-risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information (which can include the results of medical, toxicologic, and epidemiologic studies and data collected in disease registries) to evaluate the possible health effects that exposures may cause. The science of environmental health is still developing, and information on the health effects of certain substances sometimes is not available.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its effects on their health. Therefore, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, ATSDR distributes an early version to the public for their comments. In the final version of the report, ATSDR addresses all the public comments that have been presented about the document.

Conclusions: The report presents conclusions about the public health threat, if any, posed by contamination at a site. In the public health action plan, ATSDR will recommend ways to stop or reduce exposure to the contamination. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if an urgent health threat exists, ATSDR can issue a public health advisory that warns people of the risks. ATSDR also can recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies, or research on specific hazardous substances.

Comments: After reading this report, if you have questions or comments, we encourage you to send them to us.

Please address letters to:

Attention: Manager, ATSDR Record Center, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (F-09), Atlanta, GA 30333

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

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List of Abbreviations and Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention
CREG	Cancer Risk Evaluation Guide
CSF	cancer slope factor
CV	comparison value
EMEG	Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
HOD	health outcome data
HQ	hazard quotient
LDEQ	Louisiana Department of Environmental Quality
MCL	Maximum Contaminant Level
µg/dL	microgram per deciliter
µg/L	microgram per liter
mg/kg	milligrams per kilogram
MRL	Minimal Risk Level
NOAEL	no observed adverse effect level
NPL	National Priorities List
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PHA	Public Health Assessment
ppb	parts per billion (also expressed as µg/L or microgram per liter)
RBC	Risk Based Concentration
RMEG	Reference Dose Media Evaluation Guide
RSL	Regional Screening Level
SI	site investigation
SVOC	semi-volatile organic compounds
TPH	total petroleum hydrocarbons
VOC	volatile organic compounds

Summary

Introduction	One of the Agency for Toxic Substances and Disease Registry's (ATSDR's) goals is to conduct public health assessment (PHA) activities for all sites proposed for or listed on the U.S. Environmental Protection Agency's (EPA's) National Priorities List (NPL). In May 2014, the former Delta Shipyard located in southeastern Houma, Terrebonne Parish, Louisiana, was proposed for NPL listing. When it operated, the shipyard consisted of a cleaning and repair facility for small cargo boats, fishing boats, and oil barges. Prior to 1986, boats were steam cleaned to remove oily wastes. Oil that was easily recovered was sold. The remaining oily waste from the cleaning process was stored in several unlined earthen pits that still exist today. Currently, two people reside on a parcel directly adjacent to the site and a small boat maintenance business operates on a portion of the site. It is unlikely that other individuals are accessing the site regularly. ATSDR prepared this PHA on the Delta Shipyard NPL site to determine whether exposure to site contamination from past shipyard activities could harm people's health, make recommendations for additional sampling, and identify recommendations to protect public health. ATSDR reached the following conclusions in this PHA.
Conclusion 1	Incomplete data exist to fully evaluate the surface soil in and around the area of the pits and ditch. Although exposure to the remote area of the pits is unlikely, ATSDR used the limited, available samples to evaluate exposures to the resident, children visitors and workers for health protectiveness. Based on the available data, individuals are not expected to be harmed from exposure to contaminants in surface soil on and near the pits and ditch.
Basis for Conclusion 1	While many samples were collected to evaluate migration, a limited number were appropriate for a PHA. Eight samples were collected from the surface of the pit area and four samples were collected from the surface of the ditch along with additional duplicate samples. There are data quality issues that limit a full determination of the health risks. An evaluation of the limited data indicates that harmful effects are not expected for residents, children visitors and workers who may come in contact with surface soil at the site in the pit area and ditch.
Recommendations	Although the data evaluation in this PHA provide some understanding of potential exposures at the site, the results are limited in nature (Ex: few surface samples, laboratory analysis limitations). It is recommended that additional surface soil samples be collected in the pit and ditch areas as well as others portions of the site that are more easily accessible. Heavy metal analysis should include a method to determine the form of the metals or the toxic leaching characteristics. It is recommended that access to the site be limited.

Conclusion 2	Site conditions make frequent contact with surface water and sediments in the canal very unlikely. Chemicals are present in water and sediments in the canal at very low concentrations. Therefore, infrequent exposure to surface water and sediments is not expected to harm people's health.
Basis for Conclusion 2	It is not likely for people to come in contact with the low levels of contaminants present in the canal as it is remote and expected to be unappealing to recreationists.
Conclusion 3	ATSDR cannot conclude whether eating fish, shellfish, or other marine life caught near the site could harm people's health.
Basis for Decision 3	ATSDR does not have the information to determine if people's health could be harmed from eating fish, shellfish and other marine life caught near the site. There are no reports of recreational or commercial fishing near the site, but crabbing has been reported nearby. The sediment in the deep water near the site has low levels of chemicals and there are other industries near the shipyard. There are currently no fishing restrictions in the area.
Recommendations	Because there are low levels of chemicals present in sediments in the canal, it is recommended that fish, shellfish, other marine life sampling be collected so we may have the information needed to evaluate exposures to people who may consume them.
Conclusion 4	ATSDR concludes that based on available data, people are not exposed to chemicals from the site through their drinking water.
Basis for Decision 4	A public water supply distributes drinking water to homes within 4 miles of the site. Water samples collected near the intake to the public water supply do not show site impact. Registered, private wells in the area are located greater than 1 mile from the site and are unlikely to be impacted by site activities.
Recommendations	As there are no reports of house-to-house surveys for unregistered wells, it is recommended that this effort be undertaken to identify any unregistered wells in the area so that those wells can be evaluated.
For More Information	Call ATSDR at 1-800-CDC-INFO and ask for information on the Delta Shipyard site in Louisiana.

Purpose and Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this Public Health Assessment (PHA) on the Delta Shipyard to determine whether site contamination could harm people's health. ATSDR is mandated by law to conduct public health assessment activities for all sites proposed for or listed on the U.S. Environmental Protection Agency's (EPA's) National Priorities List (NPL). ATSDR assesses the potential human health consequence of exposures to toxic substances found on and associated with NPL sites. This PHA evaluates how people contact the contamination, the likelihood that they will experience harmful health effects, and makes recommendations for preventing those exposures.

In January 2012, the LDEQ asked the EPA for assistance in evaluating this site. LDEQ was concerned that the site would continue to pose a risk to the environment. EPA evaluated Delta Shipyard's three pits and the drainage ditch using the Hazard Ranking System (HRS), and found them to pose sufficient hazards to the adjacent waterways to be placed on the National Priorities List (NPL). In February, LDEQ sent a letter of concurrence. In May 2014, EPA finalized their HRS assessment and nominated Delta Shipyard to the NPL [EPA 2014]. On September 16, 2014, EPA released the news that the Delta Shipyard was added to the NPL.

The Delta Shipyard was a cleaning and repair facility for small boats and oil barges. When it operated, (dates undocumented), boats were steam cleaned to remove oily wastes. Oil that was easily recovered was sold. The remaining oily waste from the cleaning process was stored in several unlined earthen pits used as evaporation ponds. Oil-field drilling sludge was also disposed there. The pits and the areas surrounding them consisting of 11 acres are considered the NPL site [EPA 2014].

Background

Site History and Use

The Delta Shipyard was located at 200 Dean Court in southeastern Houma, Terrebonne Parish, Louisiana. The Delta Shipyard site was part of a large industrial park covering 165 acres and home to seven divisions of Delta Ironworks. The shipyard was the only division that was reported to handle hazardous wastes. It was owned by Delta Ironworks from 1959 until 1980 when the property was sold to Chromalloy American Corporation. In 1986, much of the industrial park (110 of 165 acres) was purchased by Delta Services, including the property used by the Delta Shipyard [Weston 1996; Weston 2013a; EPA 2014]. In 1989, Dean Boats, Inc. purchased the property and operates Elevated Boats Incorporated who maintains an active fabrication plant/office building on-site. Portions of the 110 acres are leased to other industries [Weston 2013a].

Delta Shipyard consisted of a cleaning and repairing facility for small cargo vessels, fishing vessels, and oil barges. The vessels were steam-cleaned and the oily wastes were removed. The generated oils and wastewater were sent through a separation process after which the waste oil was recovered and sold. Wastes were stored in surface impoundments on-site [Weston 2013a].

Two waste pits approximately 40 feet by 75 feet by 2 feet deep, are located 100 feet east of the fabrication building. The pits were used to dispose of waste oil and oil field drilling sludge material. These pits were sampled and closed by filling in 1984 under the supervision of the Louisiana Department of Environment Quality (LDEQ) Hazardous Waste Division. The area is now used as a parking lot for the 20 current employees. Two monitoring wells are located around the closed pits;

however, during the site investigations in 1994, only one could be located [Weston 1994, 1996; EPA 2014].

Four larger pits (roughly 300 feet by 150 feet) are located approximately 800 feet south of the fabrication building and are surrounded by dense vegetation. Three pits (Pit 1, 2, and 3) are located east of Plant Shell Road. Another pit (Pit 4) is located west of Plant Shell Road. According to a Wink Engineering sampling report in 1985, Pit 4 actually consists of three smaller pits in series that have been covered over with fill material. Subsequent reports consider these pits as one single pit. The three pits east of the road are barren, open and a crusty black substance appears at the surface [Weston 1994, 1996]. Raised berms surround Pits 1 – 3, but are not maintained, contain heavy vegetation, and appear to be insufficient to contain the contents of the pits during a rain event. Beside the 3 pits is a ditch leading to the canal [Weston 1994].

Surface water runoff draining from the site flows into Bayou La Carpe. Bayou La Carpe enters the Houma Navigational Canal just south of the site. According to the Houma, Louisiana, 7.5- minute wetlands map, the Houma Navigational Canal is bordered by extensive wetland areas [Weston 1994, 1996].

The site is fairly accessible to the general public by both vehicle and foot. However, the site is located in an industrial park and the land has little or no recreational value [Weston 1994, 1996]. A residential trailer with two residents is just 400 ft. west of the pits. Most other residences are far from the site, but two families with children live within a quarter mile [Weston 2013a]. These families are aware of the site and have advised their children to keep away. This PHA will focus on an evaluation of the possible human exposures to contaminant on and near the site.

The majority of the contamination of concern is 800 feet south of an on-site corrugated metal building. The contaminated land can be described as non-tidal transitional freshwater wetlands. These wetlands are at the west side of the Company Canal that branches north from Bayou LaCarpe and Houma Navigation Canal. Figure 1 shows the relative location of the Delta Shipyard site compared with the charted waterways of southeast Houma. A circular insert of a satellite photograph shows the current features of the former shipyard. An arrow points to vegetative growth where the majority of the contamination is found. The berm and area surrounding the pits is heavily vegetated with scattered willow and other small trees, bamboo thicket, grasses, and weeds [Weston 1996, 2012, 2013a].

Figure 1. NOAA Chart of South Houma's Canals and Bayous with Delta Shipyard Site Location

Source: Base Chart provided by the National Oceanographic and Atmospheric Administration (NOAA): http://www.charts.noaa.gov/PDFs/11355.pdf; Circular insert provided by Google Maps.

Environmental Investigations

Environmental investigations have been conducted since 1980. The data support that oils and oil-exploration related wastes are in the pits and some has migrated into the marine environment. Rains have washed site pollutants into a ditch and into the neighboring canal. The ditch contains pit-related contaminants and the soil adjacent to the ditch has some contamination. Some contaminants are found in canal sediments several hundred feet downstream from the site.

During the environmental investigations the soil and sediment from the pits, ditches, and canal were analyzed. Some heavy metals, volatile organic compounds (VOCs), semi volatile organic compounds, including polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) were detected.

Barium was found in the pits, in the ditch, and in the canal sediments at nearly the same levels [Wink 1985; LDEQ 1986; Weston 1994, 1996, 2013a; EPA 2014]. The form of barium used for petroleum exploration does not dissolve well [Targuchi 20009]. Other less soluble oil-related components also remain, while much of the more soluble chemical components are only found in small pockets or at depth in the soils. PAHs are not very soluble, but the decreases in concentrations from pits, to ditch, to canal sediments suggest that they have undergone microbial decomposition as seen in other studies [ATSDR 2007a, 2007b; Styes 2014, 2015; Osu 2005, 2010; Osuji 2006]. Plants and animals in the wetlands near the site have not been studied and may have some contamination as observed in other studies elsewhere [Bakker 2000]. The degradation of some contaminants is consistent with wetland microbial activity of oil wastes [Weston 1994, 1996, 2012b; Gosselink 1993; EPA 1993, Styes 2014, 2015]. A discussion of the site contaminants including their fate and transport is presented in Appendix B.

Between 1981 and 1996, the following investigations were conducted:

- <u>3 to 4 November 1980</u>: Soil Testing Engineers, Inc. completed two 50-ft soil borings adjacent to the two closed pits located near an on-site office building. Soil boring samples revealed the presence of silt and clay throughout the boring interval. The clay in the 0- to 15-ft range was found to have very low permeability (ranging from 10^{-7} to 10^{-8} centimeters per second [cm/sec]. Thus, it should resist migration to groundwater. Two monitoring wells were installed near the borings to depths of 13 and 20 ft below ground surface (bgs) [Weston 1996].
- <u>11 March 1981</u>: EPA contractors conducted a Preliminary Assessment and Site Inspection. The reports indicated that the site received five hundred 55-gallon drums per year containing oily wastes and that the associated waste manifests were maintained on-site. A list of Delta Shipyard's primary customers was also provided [EPA 1981].
- <u>10 May 1983</u>: The Louisiana Department of Natural Resources (LDNR) performed an inspection of the site and issued a Notice of Violation. Eight violations were noted, among these were that "there was no indication that (the) facility was having their waste treated, stored, or disposed of at a (permitted) hazardous waste facility," and the "facility has not developed and adhered to a groundwater sampling and analysis plan" [LDNR 1983].
- <u>12 September 1984</u>: The Earth Technology Corporation completed an EPA Site Inspection. The report summarized the closure of the two waste oil pits in early 1984. The pits were first drained and samples of the oil sludge remaining in the bottom were collected. The sludge samples were then analyzed for corrosivity, toxicity, ignitability, and reactivity. Following LDEQ review of the sample results, the remaining sludge was mixed with 30 cubic yards of sandy soil prior to backfilling. Following the pit closures, an aboveground storage tank was installed to replace the pits in the oil-water separation process [Weston 1996].
- <u>June 1985</u>: Wink Engineering collected sludge samples from Pits 1 through 4. The report indicated that Pits 1 through 3 were uncovered, and Pit 4 was covered with a thin crust of fill

material. The samples were analyzed for volatile organic aromatics, cyanide, total phenol, flash point, pH, toxicity, and oil and grease [Wink 1985].

- 16 April 1986: LDEQ collected samples from on-site tanks and pits. The tanks were reportedly used in conjunction with the steam cleaning operation. The pit samples included two composites from the closed pits and three grabs from Pits 1 through 3. The samples were analyzed for VOCs, metals, and PCBs. However, the laboratory analytical data are not included in available file information [LDEQ 1986].
- December 1994: EPA contractors completed a Site Inspection Prioritization (SIP) report. A limited number of pit sludge and drainage ditch sediment samples were collected in and around Pits 1 through 4 during the investigation. During field activities water was observed flowing from the Pit 2 overflow pipe into the drainage ditch. The analytical results revealed the presence of elevated concentrations of several semi volatile organic compounds (primarily PAHs) and metals in the surface soils [Weston 1994].
- December 1996: EPA contractors conducted an Expanded Site Inspection (ESI) of the Delta Shipyard site. As part of the ESI, 7 pit sludge samples, 6 surface and subsurface soil samples, 2 ground water samples, 4 surface water samples, 37 stream sediment samples, and 6 field Quality Control samples were collected [Weston 1996]. The subsurface pit sludge sample results indicated elevated concentrations of 2-methylnaphthalene, naphthalene, phenanthrene, ethylbenzene, toluene, xylenes, chromium, lead, and zinc. Of these, the highest concentrations were the PAHs [Weston 1996, p. 40]. In addition, samples collected from ground water, surface water, and surface soil indicated an elevated presence of PAHs, indicating migration of these contaminants from the pits to the surrounding media. This data provided limited exposure information as most of the samples were collected in areas not accessed by visitors.
- August 2012: EPA contractors collected 16 surface water and 16 sediment samples from locations within Company Canal, Houma Navigation Canal, and Bayou La Carpe; 17 surface soil/sediment samples and 51 subsurface soil samples (including 3 duplicates) from overland flow areas at the Delta Shipyard site; and 14 waste samples from various depths at the open pits at the site. The background surface water and sediment samples were collected from locations upstream of the facility within Company Canal and from within upstream waterways entering the surface water in order to determine whether contaminants had been released from the site. [Weston 1996, 2012, 2013a].

Discussion

Data Sources and Limitations

The data evaluated in this PHA include those collected prior to the site being listed on the NPL. In the 1980s and 1990s, there were several investigations. There was one investigation in 2012 that provided additional data about deep site soils and additional data on the canal. These investigations collected some of the data to identify contaminants and sources. Although the investigations identify the areas that are highly contaminated, they do not characterize the full extent of the contamination throughout the entire site, particularly the areas that are more easily accessible. They also do not provide full information on the solubility or leachability of the contaminants. While potential exposures based on the available data have been evaluated in this report, the data are not adequate for a comprehensive assessment of human health risks. Better characterization of site contamination is necessary for a thorough assessment of human health exposures.

The following summary of the data was evaluated for human exposures as part of this PHA:

- 6 surface soil and 2 sediment samples in and around the pits (and duplicate samples);
- 4 surface soil and sediment samples in the ditch (and duplicate samples);
- 9 sediment samples in the canal and further downstream (and the duplicate samples);
- 4 surface water samples in the canal;
- 1 round of raw and treated public water samples collected at the closest intake;

Additional data reviewed that do not represent site exposures: Many samples were collected at this site to evaluate the ecologic impact and the potential for migration. For example, during one investigation 37 stream sediment samples were collected [Weston 1996]. Additional surface water and sediment samples were collected downstream during other investigations [Weston 2012]. Numerous sub surface soil samples were also collected during many site investigations as well as one other surface soil sample collected up-gradient of the Pits [Weston 1996].

ATSDR evaluated this data to determine the fate and transport of the chemicals. Exposure to chemicals at depth was not evaluated because contact is unlikely. Although the up-gradient soil sample contained lower levels of the chemicals than those found in the pits and ditches, it was in very close proximity to the pits and could not be used to assess exposures outside the area of the pits.

It should be noted that there are laboratory limitations regarding some of the data collected and analyzed. Specifically, there was no speciation or leachability of the metals data in soils or sediment that would indicate the form of the metal present in the sample. For some chemicals, there were possible laboratory analysis concerns as well as detection limits that were set too high to allow for a full evaluation of contaminant exposures. Additionally, some soil and sediment samples near the surface were collected using a geoprobe and represented 0-12 inches [Weston 2013]. These results were similar to the sample results collected on and closer to the surface, but the results of which were more useful in fate and transport analysis rather than human exposure assessment.

Exposure Pathways Analyses

Contamination from the Delta Shipyard site will only pose health risks if people come in contact with these chemicals. To determine if, and how, people could be exposed to site-related contamination, ATSDR conducted an exposure pathway analysis by evaluating the following:

- a source for the chemicals,
- a medium (e.g., water, soil, air) in which the chemicals are found,
- a point or location where people come into contact with the chemicals,
- a route by which people have physical contact with the chemicals, and
- a population that could come into contact with the chemicals.

In a completed exposure pathway, all five of these elements are present. A completed pathway means there is a strong likelihood that people have been or are currently being exposed to a chemical. In an eliminated exposure pathway, at least one of the five elements is absent. This means that past or current exposure to a chemical is unlikely. In a potential exposure pathway, one or more of the elements may be absent, but additional information is needed before eliminating the pathway.

ATSDR identified four exposure pathways for the Delta Shipyard site, which are summarized in Table 1. Exposure pathways are considered to be "potential" pathways primarily because we do not know if people are actually coming into contact with chemicals through these pathways. Site reports suggest few people currently are accessing the areas that are most contaminated.

Table 1. Exposure Pathways. Delta Shipyard, Houma, Terrebonne Parish, LA.

Pathway	Pathway Type	Time	Media and Transport	Point of Exposure	Route of Exposure	Potentially Exposed Population
Contact with surface soil/sediment (pits, ditch)	Potential	Past Current Future	Surface soil	Soil and dust onsite	Ingestion, inhalation, dermal contact	Site workers Residents Visitors
Contact with sediment covered by water and surface water	Potential	Past Current Future	Sediment	River bottom on- and off-site	Ingestion, dermal contact	Site workers Residents Visitors
Consumption of contaminated fish and shellfish	Potential	Past Current Future	Fish tissue via contaminated sediment	Fish and shellfish tissue	Ingestion	Consumers of locally caught fish and shellfish
Contact with contaminated groundwater	Incomplete	Past Current Future	Groundwater	Off-site private drinking water wells	Ingestion, dermal contact	Residents on public water supply

Selection of Contaminants of Concern/Comparison Value Screening

For each of the potential or completed pathways, ATSDR identified the relevant environmental data collected during the investigations and compared these data to human health-based comparison values (CVs) to determine if further evaluation of the contaminant was needed. CVs represent the contaminant levels in soil, water, or air that people could be exposed to on a daily basis and not experience harmful health effects. CVs are not environmental clean-up levels, and chemicals that exceed their CVs will not necessarily pose health risks. If site contaminant levels are below CVs, ATSDR exclude these chemicals from further analysis because they are not expected to harm human health. If contaminant levels are above CVs, they are identified as contaminants of potential concern that require further site-specific evaluation.

Delta Shipyard collected oil waste from ships and were reported to have received additional oil-exploration wastes. These facts suggest that several metals identified in the pits were from barium sulfate and sodium chromate which are much less toxic than other forms of these metals. For health protectiveness, CVs for the most toxic forms of the metals were used for the CV screening, as speciation of the metals was not performed.

Drinking water is not considered to be a completed pathway at this site. The region within four miles of the site has a treated public drinking water supply from the Terrebone Parish water system which undergoes routine testing. The nearest public surface water intake is more than two miles away from the site and that intake has been sampled—showing no site-related contamination. No drinking or irrigation wells have been identified near the site [DOTD & USGS 2014; Weston 1996, 2012b, 2013].

There are 41 active wells registered in the Mississippi River alluvial aquifer in Terrebonne Parish, including 12 industrial, 11 irrigation, 9 domestic, and 9 public supplies. Depths of these wells ranged from 165 to 320 ft bgs, with a median well depth of 240 ft [DOTD & USGS 2014]. Based on the depth of the wells, distance from the site (greater than one mile), and groundwater conditions, these active registered wells are unlikely to be impacted by the site.

Evaluation of Exposure to Surface Soil and Sediment on and Near the Pits

The most noteworthy exposure pathway is contact with contaminants in surface soil[1] in the pits and in the area adjacent to the pits that were investigated. Workers at the site, residents (currently two people reside adjacent to the site), or visitors could potentially be exposed to contaminants in surface soil by accidentally swallowing small amounts of contaminated dust or absorbing chemicals through skin contact with soil.

The photograph below, Figure 2, identifies the low vegetative cover on Pit 1 surrounded by small trees and shrubs with the one residence in the upper left. As shown, this is a very remote area that is not likely routinely accessed by people.

Figure 2: Photograph of Pit 1 Showing some Residues and Little Vegetation (Source: Weston 2012b)

As part of the exposure evaluation, ATSDR evaluated six sediment samples collected near on the surface of or near the pits as well as two soil samples collected on Pit 4 (along with the duplicate

[1] ATSDR considers surface soil as soil collected on the top 3 inches of the soil. Such information was available in some of the sampling reports on Delta Shipyard.

samples).[2] In general, surface soil in the pits contains heavy metals and PAHs along with trace levels of many other contaminants. There were elevated levels of some PAHs and metals in the ditch as well and to a lesser degree in the soils nearby. Characterization of the surface soil and sediment in and around each of the pits has not be completed. While ATSDR evaluated the available soil and sediment data from the area of the pits to provide some understanding of the human health risks from exposure more data is necessary to better understand potential exposures to pit contaminants and other more easily accessible areas of the site which have not been sampled.

Table 2 provides a summary of the surface[3] sampling data, health-based comparison values (CVs), and conclusions about the need for further evaluation of the contaminants. ATSDR CVs were used, when available. In their absence, the EPA Regional Screening Levels were in the screening evaluation. Results below the CVs were excluded from this table except when they were above background levels. A complete discussion of the CV screening process is presented in Appendix C.

[2] Six sediment samples (numbered 1, 2, 3, 5, 6, 7) collected near or on the surface of the pits contained site contaminants. Another sediment sample (number 4) collected up-gradient of Pit 1 had little or no contamination was not included to represent the pits. Two surface soil (not sediment) samples were collected on Pit 4 that also contained site contaminants.

**Table 2. Surface Soil and Sediment Samples on and near the Pits [Weston 1994, 1996]
Delta Shipyard, Houma, Terrebonne Parish, LA**

Contaminants	Range of Detected Concentrations (mg/kg)	Frequency of Detection	Comparison Value (adult) (mg/kg)	Comparison Value (child) mg/kg	Screening Conclusion Selected for Further Evaluation (Yes/No)
Arsenic	4.5–29.7	8/8	210 [a,e]	**15** [a,e]	**Yes**
Barium	11,900–20,500	8/8	140,000 [a]	**10,000** [a]	**Yes**
Chromium*	27.8–527	8/8	630 [a,b,e]	**45** [a,b,e]	**Yes**
Mercury**	0.2–1.3	8/8	70 [e]	5 [e]	No
Lead	125–632	8/8	NA	**NA**	**Yes**
Cadmium	≤5	5/8	70 [a]	5 [a]	No
Benzene	≤0.73	6/8	350 [a]	13 [c]	No
Ethylbenzene	≤0.17	7/8	70,000 [e]	5,000 [e]	No
Toluene	≤0.043	7/8	14,000 [b]	1,000 [b]	No
Xylenes (total)	≤0.240	7/8	140,000 [a,e]	10,000 [a,e]	No
Chlorobenzene	≤0.021	6/8	14,000 [e]	1,000 [e]	No
2-methylnaphthalene	≤47	2/8	2,800 [e]	200 [e]	No
Naphthalene	≤12	1/8	14,000 [e]	1,000 [e]	No
Fluoranthene	≤13	5/8	28,000 [e]	2,000[e]	No
Chrysene	0.27–5.3	7/8	16 [d]	16 [d]	No
Benzo(a)pyrene***	≤4.1	6/8	0.096 [c]	0.096 [c]	**Yes More data are needed; Detection limit too high to evaluate exposure.**
Benzo(a)anthracene***	≤6	7/8	0.16 [d]	0.16 [d]	
Benzo(b)fluoranthrene***	≤6.1	7/8	0.16 [d]	0.16 [d]	
PCBs	<0.092	2/8	0.35 [c]	0.35 [c]	No
DDT, DDE, DDD	<.039	2/8	2.1 [c]	2.1 [c]	No.

Shading identifies contaminants that were selected for further evaluation.
Bold values indicate the maximum concentration exceeds the CV.
NA – Not Available
*There is no CV for total chromium and so we used the CV for hexavalent chromium, which is lower and more conservative than the CV for trivalent chromium. However, we expect that much of the chromium is trivalent in the form of sodium chromate or bound with PAHs.
**The more health-protective CVs for methyl mercury were chosen to screen total mercury.
***There is a data quality issue associated with these results.

Comparison value sources:
a) ATSDR Chronic Environmental Media Evaluation Guide (EMEG) (Sept 2015)
b) ATSDR Intermediate Environmental Media Evaluation Guide (EMEG) (Sept 2015)
c) ATSDR Cancer Risk Evaluation Guide (CREG) (Sept 2015)
d) EPA January 2015 Regional Screening Level (RSL) (June 2015)
e) ATSDR Reference Dose Media Evaluation Guide (RMEG) (Sept 2015)

From this screening assessment of soil and sediment on and around the pit area, we find that there are several chemicals that require additional evaluation to determine if harmful exposures could occur under some site-specific conditions. Based on the results of the screening analyses, ATSDR further evaluated exposures to adult residents (a business owner and his wife live on the property adjacent to the pits), children and adult visitors, and workers to arsenic, barium, chromium, lead and PAHs (specifically, benzo(a)pyrene, benzo(a)anthracene, and benzo(b)fluoranthrene) in surface soil on around the pits.

Site information indicates that there are currently no routine exposures occurring at the site. There are very few workers, no evidence of visitors, and the two residents do not routinely access the soils on the parcel known to be contaminated. However, ATSDR assumed children, between the ages of 6 to 16 years of age, and adult residents could visit the site. This is considered to be a very health-protective assumption due to the remote location of the pit areas and because they frequently are muddy. However, the possibility of exposures to these individuals have been evaluated in this report for health-protectiveness. ATSDR's assessment focused on accidental ingestion of soil by adult residents/visitors, children visitors, and workers during activities at the site. As metals are not easily taken up into the body from touching the soil, dermal exposures are not expected to contribute significantly to exposure.

ATSDR derived exposure doses for children and adults. Estimating an exposure dose requires identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in a specific medium (like soil and sediment). Exposure doses help ATSDR determine the likelihood that exposure to a chemical might be associated with harmful health effects. To evaluate the potential for non-cancer health effects, the site-specific doses derived for each individual was compared with the ATSDR Minimal Risk Level (MRL) or the EPA Reference Dose (RfD) to determine if further study was necessary. Doses that are found to be below MRLs and RfDs are not expected to result in non-cancer health effects and are not studied further. The potential for cancerous effects from exposure to arsenic, a known human carcinogen, was also evaluated. A complete discussion of the dose calculations, exposure assumptions and cancer risk estimates is presented in Appendix C.

Health Implications of Exposure to Surface Soil and Sediment on and near the Pits:

ATSDR further evaluated exposures to adult residents, children visitors and workers to arsenic, barium, chromium, lead and PAHs in soil on around the pits. It is important to note that the heavy metal analysis reported total metals, not the specific metal forms, nor the toxic leaching characteristics of the metals. Thus we assumed the most toxic forms of the metals for this evaluation.

Arsenic: Arsenic concentrations ranged from 4.5–29.7 mg/kg in the surface soil. Levels below the surface were higher. The main health concern with arsenic at these low levels is for cancer associated with daily exposure to arsenic by accidentally eating it. The average arsenic concentration used to evaluate workers and visitors (adults and children) was 16.1 mg/kg.

Exposure doses calculated for children visitors (ranging from 0.00004 to 0.00008 mg/kg/day) were below the non-cancer health guideline, EPA RfD and ATSDR Chronic Oral MRL, for arsenic of 0.0003 mg/kg/day. Adult resident and workers' doses were also below levels of health concern for non-cancer effects (0.000015 and 0.000014 mg/kg/day) respectively). Therefore, non-cancer effects from arsenic exposure are not expected for the individuals evaluated in this assessment.

Cancer risk was calculated using the EPA Oral Cancer Slope Factor of 1.5 $(mg/kg\text{-}day)^{-1}$ for arsenic. Adult residents were assumed to be exposed for 33 years (default residential exposure), children visitors for 10 years, and workers were assumed to be exposed for 25 years. Children visitors and adult residents were assumed to have a cancer risk of approximately 1 additional cancer case among 100,000 people exposed (or 1.1 x 10^{-5} and 9.4 x 10^{-6}, respectively). Workers cancer risk was estimated to be approximately 7 additional cancer cases in a million people exposed (or 6.9 x 10^{-6}). Cancer risks associated with arsenic exposure to all individuals evaluated are assumed to be low and effects are unlikely.

Barium: The available soil data does not provide speciation of the metal results. Although the form of barium that is expected to be present in pit soil (barium sulfate)[4] is a much less harmful than (barium chloride), the form the barium CV is based on, barium exposures were further evaluated assuming the harmful form to ensure health-protectiveness.

Barium concentrations ranged from 11,900–20,500 mg/kg in the surface soil on and around the pits. The average barium concentration in the pit was 17,120 mg/kg. Exposure doses calculated for children visitors (ranging from 0.04 to 0.08 mg/kg/day) were below the non-cancer health guideline, EPA's RfD and ATSDR's Chronic Oral MRL, for barium of 0.2 mg/kg/day. Adult resident and workers doses were also below levels of health concern for non-cancer effects (0.016 and 0.015 mg/kg/day) respectively. Therefore, non-cancer effects from barium exposure are not expected for the individuals evaluated in this assessment.

Barium has not been associated with cancerous effects in studies, therefore, cancer effects are not expected from exposures to barium at this site.

Chromium: As with barium, the form of chromium that is expected to be present at this site is the less toxic form (See Appendix B). For health protectiveness, it was evaluated as hexavalent chromium, the more toxic form, because the detailed metals analysis was not available.

Chromium concentrations ranged 27.8–527 mg/kg. The average was approximately 137 mg/kg. Exposure doses calculated for children visitors (ranging from 0.0004 to 0.0006 mg/kg/day) were below the non-cancer health guideline, ATSDR's Chronic Oral MRL, for hexavalent chromium of 0.0009 mg/kg/day. Adult resident and workers doses were also below levels of health concern for non-cancer effects (0.00013 and 0.00012 mg/kg/day) respectively. Therefore, non-cancer effects from chromium, even if it were all present in the most toxic form as hexavalent chromium, which is unlikely, are not expected for the individuals evaluated in this assessment.

Hexavalent chromium has been associated with cancer, but only via inhalation. As site exposures are limited to ingestion, cancerous effects are not expected from exposures to chromium at this site.

Lead: There is no known safe blood lead level and it is always a prudent public health goal to minimize exposures to lead as much as possible. Lead poses the greatest health risk to young children and the developing fetus. While the maximum concentration of lead detected in the pits (632 mg/kg) may pose a risk for children who played in this area daily, this type of exposure is not occurring. It is important to recognize that should land use change in the future, additional data should be collected and evaluated to ensure that the property is safe for long-term exposures.

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[4] Based on historical site use and solubility the barium detected on sight is likely to be barium sulfate, (See appendix B),

PAH Data Limitations: There were data limitations associated with the PAH data, as detection limits were too high to accurately report low levels of PAHs present in the samples. Additional sample collection and PAH analysis is necessary to fully characterize the contamination and evaluate exposure.

Evaluation of Exposure to Surface Soil in the Ditch

Workers at the site, residents (two people reside on an adjacent parcel), or child visitors could potentially be exposed to contaminants in surface soil by accidentally swallowing small amounts of contaminated dust or absorbing chemicals through skin contact with soil.

The photograph below, Figure 3, shows that the ditch is highly vegetated and difficult for people to access. Nevertheless, some access may be evidenced by the bottles and debris shown in the photo.

Figure 3: Photograph of the Ditch (Source: Weston 2012b)

Table 3 provides a summary of the surface sampling data in the ditch, health-based comparison values (CVs), and conclusions about the need for further evaluation of the contaminants. ATSDR CVs were used, when available. In their absence, the EPA Regional Screening Levels were in the screening evaluation. This list includes contaminants that were above the CV and those significantly above background. A complete discussion of the CV screening process is presented in Appendix C.

As part of this evaluation, ATSDR evaluated 4 surface soil samples collected in the ditch (along with two duplicate samples). There are some data limitations, which does not permit an accurate exposure assessment of the ditch. The samples were collected from the top 6 inches of sediment using a disposable scoop. While this does not represent the top 3 inches preferred by ATSDR, it was better than other site samples which represented the top 12 inches. There were also some laboratory data quality limitations with the samples, but the results were similar to results found in samples collected at depth. While ATSDR evaluated the ditch sample to provide some understanding of the human health risks from exposure, it should be clearly noted that samples closer to the surface (top 3 inches) and of better quality are necessary to better understand potential exposures to ditch contaminants. Furthermore, more samples are needed for the other more easily accessible areas of the site which have not been sampled.

Table 3. Surface Soil Samples in the Ditch [Weston 1996]
Delta Shipyard, Houma, Terrebonne Parish, LA

Contaminants	Concentration (mg/kg)	Frequency of Detection	Comparison Value (adult) (mg/kg)	Comparison Value (child) (mg/kg)	Screening Conclusion Selected for Further Evaluation (Yes/No)
Barium	11,200–22,500	4/4	140,000 [a]	**10,000 [a]**	**Yes**
Chromium*	≤232	4/4	630 [a,b,d]	**45 [a,b,d]**	**Yes**
Cadmium	≤2.2	¾	70 [a]	5 [a]	No
2-methylnaphthalene **	≤1.5	2/4**	2,800 [d]	200 [d]	**Yes Data Quality Issue; More data are needed.**
Naphthalene **	≤0.86	2/4**	14,000 [d]	1,000 [d]	
Chrysene **	≤0.47	3/4**	1.6 [c]	1.6 [c]	
Benzo(k)fluoranthrene **	≤1.1	4/4**	45 [c]	2.1 [c]	
Benzo(a)anthracene **	≤1.1	/4**	0.16 [c]	0.16 [c]	**Yes. More data are needed; Detection limit too high to evaluate exposure.**
Benzo(b)fluoranthrene **	≤1.1	4/4**	0.16 [c]	0.16 [c]	

Shading identifies contaminants that were selected for further evaluation.
Bold values indicate the maximum concentration exceeds the CV.
*There is no CV for total chromium and so we used the CV for hexavalent chromium, which is lower and more conservative than the CV for trivalent chromium. However, we expect that much of the chromium is trivalent in the form of sodium chromate or bound with PAHs.
**There is a data quality issue associated with these results, which might have resulted with a false detection or improper quantification of chemicals.

Comparison value sources:
a) ATSDR Chronic Environmental Media Evaluation Guide (EMEG) (Sept 2015)
b) ATSDR Intermediate Environmental Media Evaluation Guide (EMEG) (Sept 2015)
c) EPA January 2015 Regional Screening Level (RSL) (June 2015)
d) ATSDR Reference Dose Media Evaluation Guide (RMEG) (Sept 2015)

From this screening assessment of ditch surface soil, we find that there are several chemicals that require additional evaluation to determine if harmful exposures could occur under some site-specific conditions. These contaminants are barium, chromium, and PAHs (specifically, benzo(k)fluor-anthracene, benzo(a)anthracene, and benzo(b)fluoranthrene). ATSDR used the same exposure scenarios as those used to evaluate surface soil exposure in the pits to evaluate the ditch. A complete discussion is presented in Appendix C.

Health Implications of Exposure to Surface Soil and Sediment in the Ditch:

Barium: As previously, mentioned, to be protective, we assumed that the more toxic form of barium is present at the site although metal speciation data is unavailable.

Barium concentrations ranged from 11,200–22,500 mg/kg in the surface soil on and around the pits. The average barium concentration in the pit was approximately 17,325 mg/kg (using the higher of the two values received in the duplicate analysis). Exposure doses calculated for children visitors (ranging from 0.04 to 0.08 mg/kg/day) were below the non-cancer health guideline, EPA's RfD and ATSDR's Chronic Oral MRL, for barium of 0.2 mg/kg/day. Adult resident and workers doses were also below levels of health concern for non-cancer effects (0.016 and 0.015 mg/kg/day) respectively). Therefore, non-cancer effects from barium exposure are not expected for the individuals evaluated in this assessment.

Barium has not been associated with cancerous effects in studies; therefore, cancer effects are not expected from exposures to barium at this site.

Chromium: As with barium, the form of chromium that is expected to be present at this site is the less toxic form, but we used the toxicity values for hexavalent chromium, the more toxic form (See appendix B) to be protective of public health.

Chromium concentrations ranged 44 to 232 mg/kg. The average was approximately 118 mg/kg (using the higher of the two values received in the duplicate analysis). Exposure doses calculated for children visitors (ranging from 0.0003 to 0.0005 mg/kg/day) were below the non-cancer health guideline, ATSDR's Chronic Oral MRL, for hexavalent chromium of 0.0009 mg/kg/day. Adult resident and workers' doses were also below levels of health concern for non-cancer effects (0.00011 and 0.00010 mg/kg/day) respectively. Therefore, non-cancer effects from chromium, even if it were all present in the most toxic form as hexavalent chromium, which is highly unlikely, are not expected for the individuals evaluated in this assessment.

Hexavalent chromium has been associated with cancer, but only via inhalation. As site exposures are limited to ingestion, cancerous effects are not expected from exposures to chromium at this site.

PAH Data Limitations: As previously discussed, there are data limitations associated with the PAH data as detection limits were too high to accurately report low levels of PAHs present in the samples. Additional sample collection and PAH analysis is necessary to fully characterize the contamination and evaluate exposure.

Evaluation of Exposure to Canal Water and Sediments Covered by Water

Another potential exposure pathway may exist in the Company Canal or immediately adjacent waters where people may come in contact with sediments on the bottom of canal (covered by water) as well as surface water. Recreational access to the canal is completely unlikely and in the event that it occurs, it is very infrequent.

Numerous sediment and water samples were collected during several investigations in the canal adjacent to the site and at great distances from the site. The closest samples (within 500 feet of the site) contained the most contamination and best represented the site-specific exposures. However, barium and some other chemicals remained elevated in the sediment 4000 feet downstream. Nine sediment samples were collected along the bottom of the canal and adjacent waters. These sediment sampled were collected 0-6 inches below the ground's surface [Weston 1996, 2013a]. Six background samples were collected to compare with this data. Table 4 includes concentrations of several sediment samples along with CVs (or screening values). The screening values are the same as those used for pit and ditch soil in Tables 2 and 3, exposure to chemicals in canal sediments is expected to be much less frequent.

Table 4. Sediment Samples in the Canal [Weston 1996, 2013a]
Delta Shipyard, Houma, Terrebonne Parish, LA

Contaminant	Range of Concentrations (mg/kg)	Frequency of Detection	Comparison Value (adult) (mg/kg)	Comparison Value (child) (mg/kg)	Screening Conclusion Selected for Further Evaluation (Yes/No)
Arsenic	6.7–12.3		210 [a,d]	15 [a,d]	No
Barium	6,500–26,300	9/9	140,000 [a]	**10,000 [a]**	**Yes**
Chromium*	≤146	9/9	630 [a,b,c]	45 [a,b,c]	No
Mercury**	≤3.5		70 [d]	**5 [d]**	**Yes**
Lead	≤207	9/9	NA	NA	Yes
Cadmium	≤1		70 [a]	5 [a]	No
Zinc	10,200 €	9/9	210,000 [a]	15,000 [a]	No
Benzo(a)pyrene	0.35 €	3/9	0.096 [c]	0.096 [c]	No
Phenanthrene	1.1 €	3/9	24,000 [c s]	24,000 [c s]	No
Fluoranthene	<1.7	5/9	28,000 [d]	2,000 [d]	No

Shading identifies contaminants that were selected for further evaluation.
Bold values indicate the maximum concentration exceeds the CV.
NA – Not Available
*There is no CV for total chromium and so we used the CV for hexavalent chromium, which is lower and more conservative than the CV for trivalent chromium. However, we expect that much of the chromium is trivalent in the form of sodium chromate or bound with PAHs.
**The more health-protective CVs for methyl mercury were chosen to screen total mercury.
€the highest values were found 4000 ft downstream. The only other detected value was the single closest value which was much lower.

Comparison value sources:
a) ATSDR Chronic Environmental Media Evaluation Guide (EMEG) (Sept 2015)
b) ATSDR Intermediate Environmental Media Evaluation Guide (EMEG) (Sept 2015)
c) EPA January 2015 Regional Screening Level (RSL) (June 2015)
d) ATSDR Reference Dose Media Evaluation Guide (RMEG) (Sept 2015)
s) This is the CV for anthracene, which has the same chemical formula ($C_{14}H_{10}$) as phenanthrene, which has no CV.

As exposure to sediments in the canal is expected to be very infrequent, dose calculations were not completed. The concentrations of barium, mercury and lead are very low and given the infrequent nature of this exposure, it is not likely that exposures to residents, child visitors, or workers would result in harm to their health.

Surface water samples were also collected in the canal and adjacent waters, four of the samples were collected in the water close to the site [Weston 2013a]. A summary of the site-related chemicals found in the 4 water samples collected in the Company Canal near the site are presented in Table 5 along with drinking water comparison values. As with the sediment samples, additional water samples were collected in the canal waters and the bayou further from the site to identify the migration off site and to provide background data.

Table 5. Company Canal Water Samples [Weston 2013a]
Delta Shipyard, Houma, Terrebonne Parish, LA

Contaminant	Range of Concentrations (mg/L)	Frequency of Detection	Comparison Value (adult) (mg/L)	Comparison Value (child) (mg/L)	Comparison with Background levels
Arsenic	0.0022-0.0028	4/4	0.011 [a,b]	0.003 [a,b]	Bayou and further waters ranged 0.0021-0.0033 mg/L
Barium	0.103-0.228	4/4	7 [a,b]	27 [a,b]	Bayou and further waters ranged 0.0726-0.0954 mg/L
Manganese	0.114-0.149	4/4	1.8 [b]	0.5 [b]	Bayou and further waters ranged 0.139-0.198 mg/L
heptachlor epoxide	<0.00005	4/4	0.0035 [b]	0.001 [b]	Bayou and further waters was also <0.0005 mg/L
Heptachlor	0.000091-0.00013	4/4	0.00046 [b]	0.00013 [b]	Bayou and further waters ranged 0.000056-0.00014 mg/L
Toluene	<0.005	4/4	0.7 [c]	0.2 [c]	Bayou and further waters was also <0.005 mg/L

Comparison value sources:
a) ATSDR Chronic Environmental Media Evaluation Guide (EMEG) (Sept 2015)
b) ATSDR Reference Dose Media Evaluation Guide (RMEG) (Sept 2015)
c) ATSDR Intermediate Environmental Media Evaluation Guide (EMEG) (Sept 2015)

The chemicals in the canal are found at concentrations lower than the CVs for drinking water. It should be noted that drinking of this water is not occurring, but the comparison has been presented to provide some perspective of the chemical concentration. With the exception of barium, all chemicals were within the range of background levels in the adjacent bayou and navigation canal. The low concentrations of these chemicals in surface water suggest that infrequent exposure by dermal (skin) contact to any of the individuals that may access the site is not likely to harm their health.

A sample collected near the closest surface water public water intake was found to have barium at 0.139 mg/L [Weston 1996], which is within the range of the waters downstream of the site as suggested by the above samples collected more recently [Weston 2013a]. These were all lower than the drinking water CVs. All other chemicals were lower near the drinking water intake. Treated water had even lower levels of these chemicals.

Consumption of contaminated fish, shellfish, or marine life

We know little about the potential exposure from the consumption of contaminated fish, shellfish, or other marine life. The immediate area does have several waterfront industries which would deter most of the fishing population, but some fishing was reported about a mile from the site [Weston 1994, 1996, 2013a].

Fish can metabolize and eliminate many of the contaminants, including the PAHs, found in the sediments near the site. However, fish are known to accumulate them when those contaminants are present in sediments at levels too high for the fish to metabolize. Once the levels are too high to be eliminated by small fish, bigger fish or scavenger fish eating the small fish begin accumulating contaminants. The chemicals that we are typically concerned about include mercury, arsenic, lead, PCBs, and PAHs (like benzo(a)pyrene). While some of these contaminants were detected in surface soil on the site, lower concentrations were detected in the sediments. Currently, there are no fish or shellfish data to evaluate the exposure potential from this pathway.

Figure 4: Company Canal from Shore (Source Weston 2012b)

Children's Health Considerations

ATSDR recognizes that infants and children may be more vulnerable than adults to exposures in communities faced with contamination of their air, water, soil, or food. This vulnerability is a result of the following factors:

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter, resulting in a greater likelihood to breathe airborne particles from indoor dust and soil, and heavy vapors close to the ground.
- Children are smaller, resulting in higher doses of chemical exposure per body weight.
- Children are more likely to mouth soil and contaminated objects and swallow more water and soil compared to adults.
- The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

Because children depend on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at and around the site. Since Delta Shipyard is an industrial work-site, it is unlikely that children will have regular access to on-site contamination in soil or to sediment contamination near the facility. There are two families nearby and the parents have informed their children not to go on site. The neighbors also include women of childbearing age. The pre-born child is particularly sensitive to some contaminants. Although their exposures are unlikely, this report presents a health-protective evaluation of children's potential exposures and makes recommendations to ensure a high level of protection for children and other potentially vulnerable groups.

Conclusions

ATSDR reached the following conclusions in this PHA.

1. Incomplete data exists to fully evaluate the surface soil in and around the area of the pits and ditch. Although exposure to the remote area of the pits is unlikely, ATSDR used the limited, available samples to evaluate exposures to the resident, children visitors and workers for health protectiveness. Based on the available data, individuals are not expected to be harmed from exposure to contaminants in surface soil on and near the pits and ditch.

2. Site conditions make frequent contact with surface water and sediments in the canal very unlikely. Chemicals are present in water and sediments in the canal in very low concentrations. Therefore, infrequent exposure to surface water and sediments is not expected to harm people's health.

3. We do not have the information to determine if people's health could be harmed from eating fish, shellfish and other marine life caught near the site. There are no reports of recreational or commercial fishing near the site, but crabbing has been reported nearby. The sediment in the deep water near the site is has low levels of chemicals and there are other industries near the shipyard. There are currently no fishing restrictions in the area.

4. ATSDR concludes that based on available data, people are not exposed to chemicals from the site in their drinking water that may harm their health.

Recommendations

1. It is recommended that additional surface soil samples be collected in the pit and ditch areas as well as others portions of the site that are more easily accessible. Heavy metal analysis should include a method to determine the form of the metals or the toxic leaching characteristics. As the site is located on private property, it is recommended that access to the site be as limited, as possible, and that people avoid accessing the site routinely for recreational purposes.
2. Because there are low levels of chemicals present in sediments in the canal, it is recommended that fish, shellfish, other marine sampling be collected so we may have the information needed to evaluate exposures to people who may consume them.
3. As there are no reports of house-to-house surveys for unregistered wells, it is recommended that this effort be undertaken to identify any unregistered wells in the area so that those wells can be evaluated.

Public Health Action Plan

A Public Health Action Plan describes the specific actions ATSDR will take to implement the recommendations outlined in this report, with the goal of preventing and reducing people's exposure to hazardous substances in the environment. ATSDR will implement this action plan in collaboration with community members, partner agencies, and other stakeholders at the Delta Shipyard site.

ATSDR will take the following public health actions:

- release this PHA report for public comment;
- communicate the results of the report to community members and stakeholders;
- release a revised or an additional report should EPA, environmental health officials, or the public indicate that there are exposures not addressed in this document;
- participate in EPA-led meetings and discussions related to the investigation and clean-up of the site;
- review additional sampling plans and environmental data at EPA's request; and
- provide technical assistance and consultation to EPA and other stakeholders as needed throughout the cleanup process.

Call ATSDR at 1-800-CDC-INFO and ask for information on the Delta Shipyard site in Louisiana.

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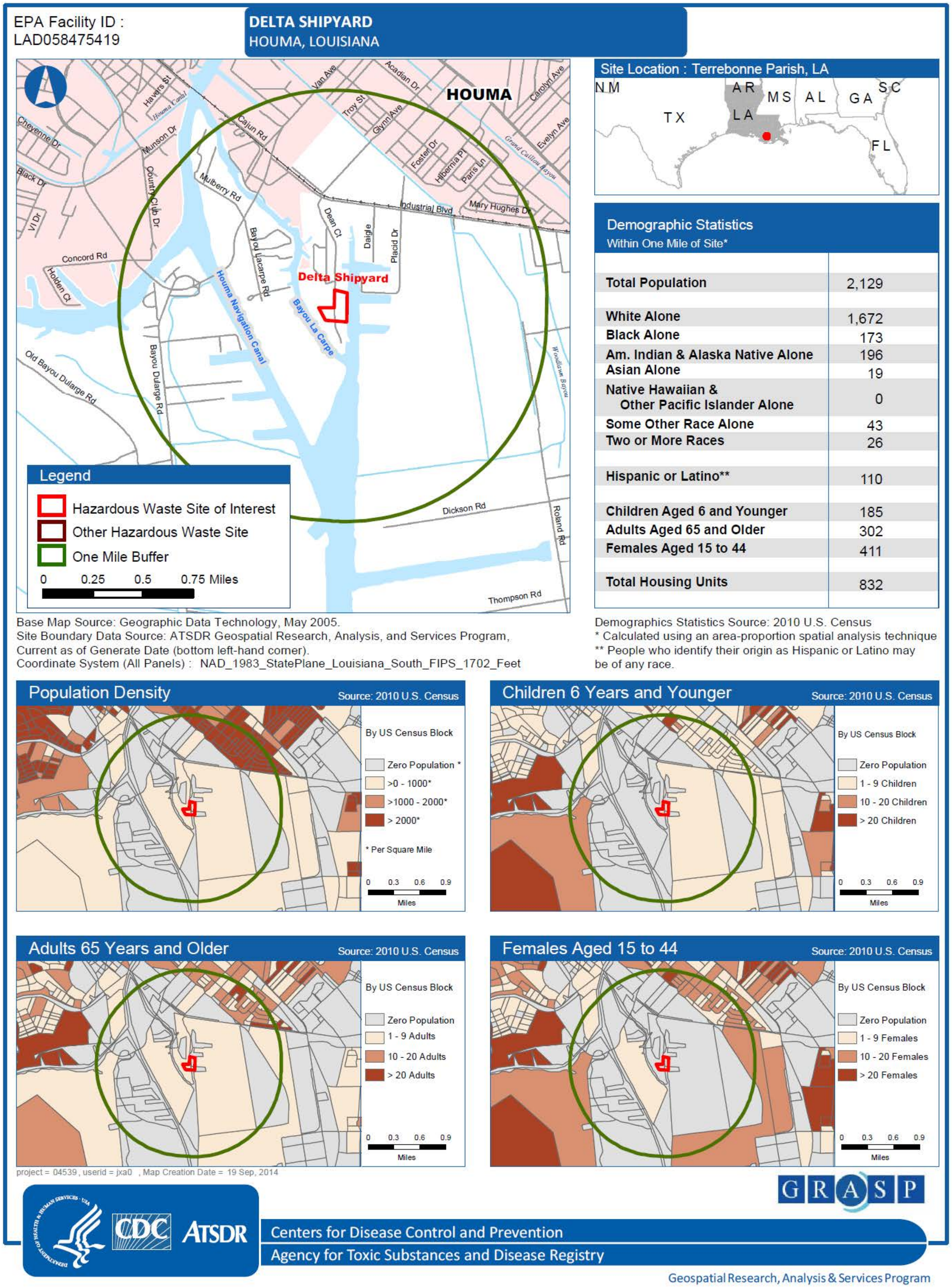
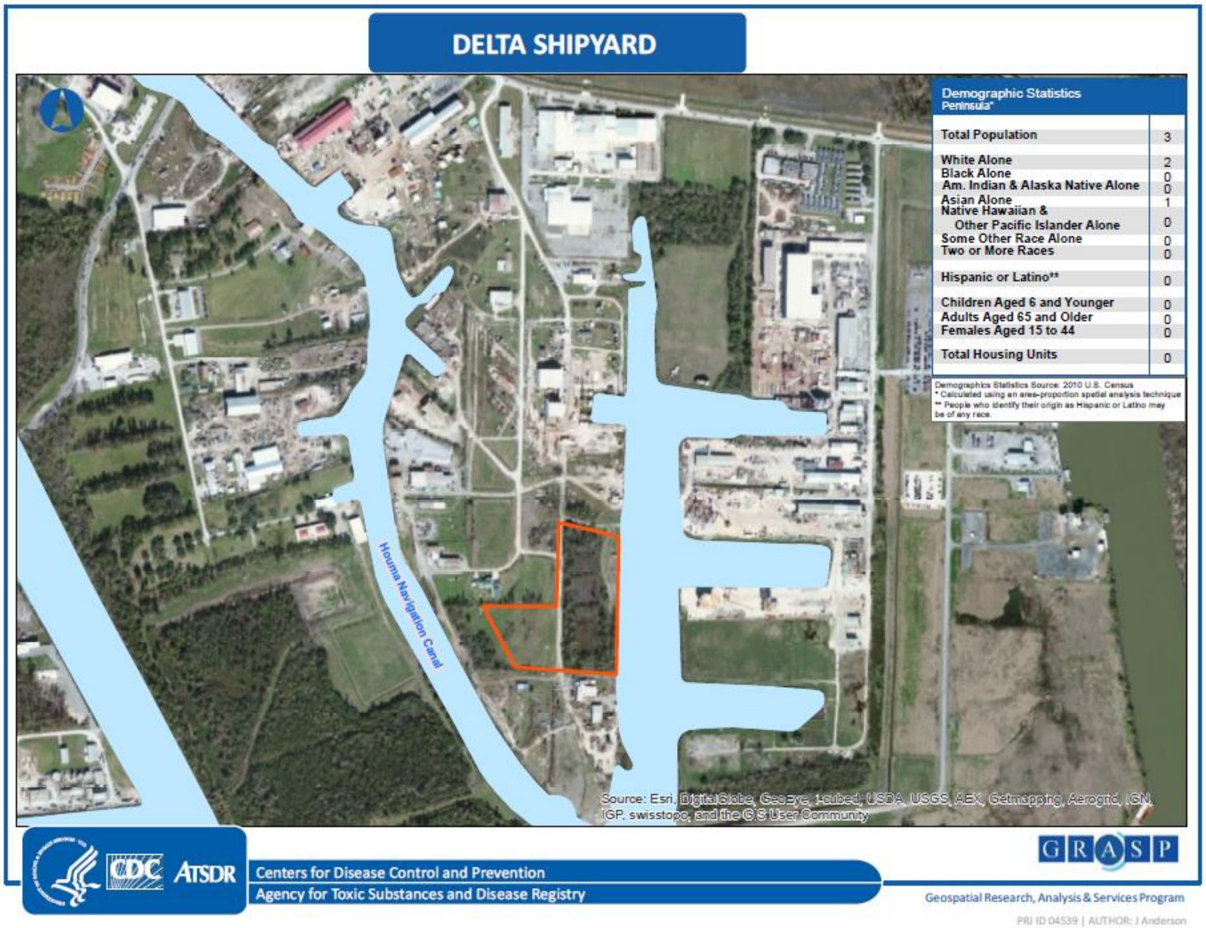
Appendix A, Figure A1: Demographic Information within One Mile of the Site



Appendix A, Figure A2: Demographic Information on the Peninsula



Appendix B: Fate and Transport Discussion

The data collected to date supports that oily liquid wastes were pumped into the pits and storm water runoff washed some of these wastes into the canal, in large part, by way of a drainage ditch. In 1985, the pits contained sludge and liquid. Sludge samples collected then contained laboratory-identified oil and grease and metals that were associated with petroleum [Wink 1985]. During one field visit in 1994, EPA contractors observed water flowing from the Pit 2 overflow pipe into the drainage ditch [Weston 1994]. During another visit, the protective berm was reported to be “absent in a low-lying area in the northeastern section of Pit 1 at the apparent location of the beginning of the on-site drainage ditch” [Weston 1996].

The pits are not lined, but the soils were found to have low permeability, so little migrates through the walls of the pit. Groundwater and boring measurements close to the pits indicate some migration to the shallow groundwater [Weston 1996, 2012a, 2013a]. Since the rainfall rate far exceeds the evaporation rate, rainwater that accumulates in the pits will either spill through overflow pipes to the drainage ditch or overflow the pits into the neighboring canal. Pit soil, ditch soil, and canal sediment sampling data support this. Downstream sediment samples show several site chemicals as does a sample collected up gradient of the pits [Weston 1994, 1996, 2012a]. There are several similarities between chemicals in the site soils and the neighboring canal sediments.

It is also important to note that the region includes other industries. Because of this, several chemicals that are found onsite are also found in the background samples. The background surface water and sediment samples were collected from locations upstream of the facility within Company Canal and from within upstream waterways. We include these chemicals in the evaluation, but the background data is important to recognize when evaluating fate and transport from the site. The fate of individual chemicals from the site is discussed in detail in Appendix B and summarized for each chemical group listed below.

Volatile Organic Compounds (VOCs)

VOCs like benzene, toluene, ethylbenzene, xylene[5], and chlorobenzene (BTEX C)[6] are found in crude oil. BTEX C are very volatile and soluble. So they will evaporate into the air and dissolve into the water. Benzene is the most soluble and most volatile. They also react uniquely with and without oxygen. We see this in the data collected over the years. No benzene was found in sludge collected from the pits' surfaces in 1985, but the other VOCs were [Wink 1985]. BTEX was detected in sediment collected from Pit 2 in 1994, but chlorobenzene was not [Weston 1994]. Levels measured in soils or sediment outside the pits at background levels. The trace measurements of BTEX-C associated for this site are consistent with old petroleum wastes.

Semi-volatile Organic Compounds (SVOCs) including Polycyclic Aromatic Hydrocarbons (PAHs)

A group of chemicals that evaporate very slowly are called SVOCs.[7] Of a number of chemicals that are semi-volatile, there are a group of hydrocarbons found in oil (and other fuels) called PAHs. PAHs are larger molecules than the (BTEX C) VOCs associated with oil, making them dissolve slower in water, over 100 times slower. They prefer to remain in oil; so a large amount of the PAHs would have been recycled along with the recovered oils. But those disposed of in the pits would not evaporate or dissolve and wash out as quickly as the VOCs. The majority of the PAHs were found in the pits [Weston 1994, 1996, 2012]. There were data limitations associated with the PAH data as detection limits were too high to accurately report low levels of PAHs present in the samples. Additional sample collection and PAH analysis is necessary to fully characterize the contamination.

Pesticides and PCBs

Trace levels of pesticides and PCBs were also found in the pits and in some of the soils adjacent to the pits [Weston 1994, 1996, 2012]. Trace levels of DDT (dichlorodiphenyltrichloroethane) and its break-down products were found on the surface of the pits [Weston 1994, Weston 2013a]. There were data quality issues associated with some of the PCB samples [Weston 1996]. However, confirmed trace levels of Aroclor 1254 were found in the pits [Weston 2013a]. As with PAHs, there were laboratory data limitations that resulted in accuracy issues with respect low level of contamination of pesticides and PCBs. Additional sample collection and improved laboratory analysis is necessary to fully characterize the contamination.

Heavy Metals

Heavy metals of interest include barium, chromium, arsenic, sodium, zinc, cadmium, and lead. All of these except barium are trace components of petroleum and all have been found in soils impacted by

[5] Xylene (X) is the name used for three chemicals (or isomers) made up of the same elements, but arranged differently making each behave slightly different. Some sample results report them as one value and some list them as separate results.

[6] Chlorobenzene is separated from the BTEX organic compounds as most literature separates the BTEX compounds from the chlorinated VOCs. Also, the other VOCs follow a predictable trend of heavier chemicals being less soluble and less volatile.

[7] The SVOC category is mentioned specifically here as the laboratory method used to identify the chemicals included several SVOCs. Other analytical methods focus on PAHs specifically, and can identify PAHs with extremely low volatility, rather than just those that are slightly volatile.

oil spills [EPA 2011a; Akporido 2013; Duyck 2007]. Barium is not in the crude, but barium sulfate is used in oil exploration [Kress 2007].

The methods used to analyze heavy metals at most sites do not provide information on their form but just the elemental portion of the metal; for example, the chemical sodium chromate would be identified as sodium and chromium individually and barium sulfate would be identified as just barium [Taguchi 2006; Kress 2007]. Therefore, process data, observation information, and other sampling data are needed to determine the form and fate of the site contaminants in the environment. Barium sulfate and sodium chromate are used as drill lubricants, corrosion inhibitors, and to increase the density of soils when drilling for oil [Kress 2007; Anger 2005]. These forms have unique fate and transport properties.

None of these metals evaporate. Of the forms that are expected on site, sodium chromate is soluble and barium sulfate is slightly soluble, but the other metals are not soluble. Thus, we would expect that sodium chromate would degrade most in the environment and zinc sulfide and cadmium sulfide least. This explains ratios of metals found in pit, in canal sediments, and in canal waters [Weston 1994, 1996, 2012a, 2013a]. More explanation is provided in Appendix B.

Transport to groundwater: There is conflicting data with regard to groundwater transport. Two groundwater samples were collected immediately adjacent to the pits. The one sample contained trace levels of metals and the other contained much higher levels –barium (29 mg/L), chromium (0.507 mg/L), lead (0.482 mg/L), and zinc (3.29 mg/L) [Weston 1996]. The comments in the sampling notes state the condition of the sample was “brown” and “cloudy”. There are many reasons that we suspect that the sample with high levels of metals was due to metals in the (brown and cloudy) sediment, 1) only trace levels of metals were in the other sample; 2) the sample was brown and cloudy; 3) the canal waters had low levels of chromium; 4) high detections of barium as well as the chromium are not expected in filtered groundwater [EPA 1994a, 1994b]. However, more groundwater data is needed to determine if it is migrating off the site.

Appendix C: ATSDR's Comparison Value (CV) Screening and Exposure Evaluation Process

ATSDR compared the available environmental data to human health-based comparison values (CVs) to determine if further evaluation of the contaminant was needed. CVs represent the contaminant levels in soil, water, or air that people could be exposed to on a daily basis and not experience harmful health effects. CVs are not environmental clean-up levels, and chemicals that exceed their CVs will not necessarily pose health risks. If site contaminant levels are below CVs, we exclude them from further analysis because they are not expected to harm human health. If contaminant levels are above CVs, they are identified as contaminants of potential concern that require further site-specific evaluation.

The following CVs were used in this PHA:

1. **Environmental Media Evaluation Guides (EMEGs)**
   EMEGs are an estimate of contaminant concentrations low enough that ATSDR would not expect people to have a negative, non-cancerous health effect. EMEGs are based on ATSDR Minimal Risk Levels (MRLs) and conservative assumptions about the public's contact with contaminated media, such as how much, how often, and for how long someone may be in contact with the contaminated media. EMEGs also account for body weight and length of exposure; chronic EMEGs are used for exposures lasting more than 365 days, intermediate EMEGs for exposures between 14 and 364 days, and acute EMEGs for exposures less than 14 days.

2. **Cancer Risk Evaluation Guides (CREGs)**
   CREGs are an estimate of contaminant concentrations that are low enough that ATSDR would expect no more than one excess cancer case in a million (10^{-6}) persons exposed during their lifetime (70 years). ATSDR's CREGs are calculated from EPA's "cancer slope factors" (CSFs) used for oral exposures.

3. **Reference Dose Media Evaluation Guides (RMEGs)**
   ATSDR derives RMEGs from EPA oral Reference Doses (RfDs), which are developed based on EPA evaluations. RMEGs represent chemical concentrations in water or soil at which daily human contact is not likely to cause negative, non-cancerous health effects.

4. **US Environmental Protection Agency Regional Screening Levels (RSLs)**
   RSLs are contaminant concentrations in soil, water, or air, below which any adverse health effects would be unlikely. RSLs are derived by EPA Regions 3, 6, and 9 Offices using EPA RfDs, provisional RfDs, and Cancer Slope Factors (CSFs). RSLs take into account both non-cancer and cancer risks.

Exposure Dose Estimates and Cancer Risk Estimates

As previously stated, the CV screening process identifies contaminants that require further site-specific evaluation. Therefore, ATSDR derived exposure doses for children and adults who may potentially come in contact with site contaminants. Estimating an exposure dose requires identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in a specific medium (like soil and sediment). Exposure doses help ATSDR determine the likelihood that exposure to a chemical might be associated with harmful health effects. To evaluate the potential for non-cancer health effects, the site-specific doses derived for each individual was compared with the ATSDR MRL or the EPA RfD to determine if further study was necessary. An ATSDR oral MRL (expressed in units of expressed in units of mg of substance/kg body weight-day or mg/kg/day) is an estimate of daily human exposure by a specified route and length of time to a dose of a chemical that is likely to be without a measurable risk of negative, noncancerous health effects. Acute MRLs are designed to evaluate exposures lasting 14 days or less. Intermediate MRLs are designed to evaluate exposures lasting from 15-364 days. Chronic MRLs are designed to evaluate exposures lasting for 1 year or longer. An EPA RfD (also expressed in units of mg/kg/day) is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Both the ATSDR MRL and EPA RfD apply uncertainty factors to study results to ensure that they are protective. Site-specific doses that are below MRLs and RfDs are not expected to result in non-cancer health effects and are not studied further. When doses exceed these health guidelines, further review and interpretation of the MRL and RfD studies and the effect levels associated with the observed health impact(s) from the study is necessary to make a health determination for the site.

ATSDR derived exposure doses for individuals exposed to contaminants in soil and sediment via incidental ingestion (see Exhibit 1).

Exhibit 1: Exposure Dose Equation for Ingestion of Soil or Sediment

$$D = \frac{C \times IR \times EF \times AF \times CF}{BW}$$

where,

D	=	exposure dose in milligrams per kilogram per day (mg/kg/day)
C	=	chemical concentration in milligrams per kilogram (mg/kg)
IR	=	intake rate in milligrams per day (mg/day)
EF	=	exposure factor (unitless)
AF	=	bioavailability factor
CF	=	conversion factor, 1×10^{-6} kilograms/milligram (kg/mg)
BW	=	body weight in kilograms (kg)

The potential for cancerous effects from exposure to arsenic, a known human carcinogen, was also evaluated. As part of its evaluation, ATSDR calculated cancer risk estimates using the US EPA arsenic oral CSF of 1.5 $(mg/kg/day)^{-1}$. Under quantitative cancer risk assessment methodology, cancer risk estimates are expressed as a probability (see Exhibit 2).

Exhibit 2: Cancer Risk Equation

Age-Specific Cancer Risk = D × CSF × (ED / 78)

where,

D = age-specific exposure dose in milligrams per kilogram per day (mg/kg/day)
CSF = cancer slope factor in $(mg/kg/day)^{-1}$
ED = age-specific exposure duration in years

For this PHA, the following key parameters were used to calculate doses and cancer risk to evaluate exposures to individuals that might access the site:

Individuals that may access site	Body Weight (kilograms)	Soil Ingestion Rate (milligrams)	Exposure Frequency (days/year)	Exposure Duration (years)
Adult Residents/Visitors	80	100	270	33
Child Visitors (Ages 6 to 16)	32-57	200	270	10
Workers	80	100	250	25